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NATIONAL DAM SAFETY PROGRAM. F. A. TOTTEN LAKE (MO 20398), OSAGE ETC(U)
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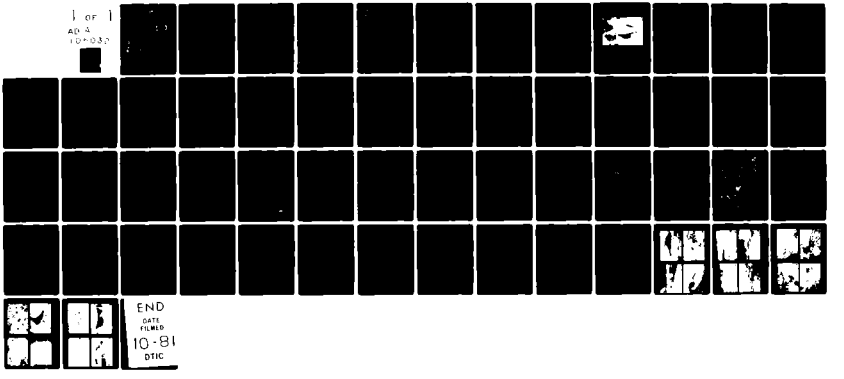

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F. A. TOTTEN LAKE

WEBSTER COUNTY, MISSOURI

MO 20398

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST 1979

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Totten, F.A. Lake Dam (MO 20398) Webster County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report. / 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Anderson Engineering, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0070
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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National Dam Safety Inspection. F. A. Totten Lake (MO 20398), Osage-Gasconade Basin, Webster County, Missouri. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: F. A. Totten Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the F. A. Totten Lake Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

30 AUG 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

30 AUG 1979
Date

F. A. TOTTEN LAKE

WEBSTER COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20398

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by

Anderson Engineering, Inc. Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction of

St. Louis District, Corps of Engineers

For

Governor of Missouri

August, 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	F. A. Totten Lake Dam
State Located:	Missouri
County Located:	Webster County
Stream:	Tributary to James River
Date of Inspection:	16 May 1979

F. A. Totten Lake Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam has been classified by the St. Louis District Corps of Engineers as a small size dam with a high downstream hazard potential. The estimated damage zone extends approximately 2.4 miles downstream of the dam. Within this zone, four dwellings and one outbuilding may be found.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass about 14 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the small volume of water impounded, and the height of the dam, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-

year frequency flood will overtop the dam. The 100-year flood is one that has a 1 percent chance of being exceeded in any given year. The 10-year frequency flood will not overtop the dam. The 10-year flood is one that has a 10 percent chance of being exceeded in any given year.

Deficiencies visually observed by the inspection team were: (1) Erosion on downstream face of the embankment above the spring, (2) Seepage at downstream right abutment contact, (3) Seepage at center of dam at toe and (4) No erosion protection for the primary spillway.

Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owner take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

John M. Healy, P.E.
Hanson Engineers, Inc.

Steven L. Brady, P.E.
Anderson Engineering, Inc.

Nelson Morales, P.E.
Hanson Engineers, Inc.

Tom Beckley, P.E.
Anderson Engineering, Inc.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

F. A. TOTTEN LAKE DAM - ID No. 20398

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of the F. A. Totten Lake Dam in Webster County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

F. A. Totten Lake Dam is an earth fill structure approximately 31 ft. high and 290 ft. long at the crest. The appurtenant works consist of an unlined earth spillway in the south abutment. Sheet 3 of Appendix A shows a plan, profile and typical section of the embankment.

B. Location:

The dam is located in the southwest part of Webster County, Missouri on a tributary of the James River. The dam and lake are within the Fordland, Missouri 15 minute quadrangle sheet (Section 2, T29N, R19W - latitude 37°14.70';

longitude 92° 58.42'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 31 ft. and a maximum storage capacity of approximately 42 acre-ft., the dam is in the small size category because the height is greater than 25 feet.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam which means that loss of life and appreciable property loss could occur in the event of failure of the dam . The estimated damage zone extends approximately 2.4 miles downstream of the dam. Within this zone, four dwellings and one outbuilding may be found.

E. Ownership:

The dam is owned by F. A. Totten. The owner's address is: Rt. #4, Marshfield, Missouri, 65706, (Telephone 417-468-4692).

F. Purpose of the Dam:

The dam was constructed primarily for recreational purposes.

G. Design and Construction History:

No design information or plans are available. The dam was constructed by the owner and completed in 1970. The material for the dam was taken from a ridge in the center of the lake. The owner indicated that the embankment material was cherty silty clay, moved with scrappers and compacted with a sheepsfoot roller. The owner stated that the dam has never been overtopped. The contractor for the job was Walter Shelton of Ozark, Missouri.

H. Normal Operating Procedures:

All flows are passed by an unlined earth spillway in the south abutment.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 56 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through an uncontrolled spillway.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 90.0): 75 cfs

(3) Estimated Capacity of Primary Spillway: 75 cfs

(4) Estimated Experienced Maximum Flood at Dam Site: Mr. Totten says that the dam has never overtopped and that the lake level only rises a few inches after a heavy rain.

(5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(7) Gated Spillway Capacity at Pool Elevation: Not Applicable

(8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations: (Based on arbitrary BM=100.0 Elevation on top of concrete corner post at southwest corner of yard on abutment)

(1) Top of Dam: Measured 90.0 (Average)

(2) Principal Spillway Crest: Measured 88.5

(3) Emergency Spillway Crest: Not Applicable

(4) Principal Outlet Pipe Invert: Not Applicable

(5) Streambed at Centerline of Dam: Measured 59.2

(6) Pool on Date of Inspection: Measured 88.63

(7) Maximum Tailwater: Unknown

(8) Upstream Portal Invert Diversion Tunnel: Not Applicable

(9) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 935 Feet

(2) At Principal Spillway Crest: 900 Feet

(3) At Emergency Spillway Crest: Not Applicable

E. Storage Capacities:

(1) At Principal Spillway Crest: 36 Acre-Feet

(2) At Top of Dam: 42 Acre-Feet

(3) At Emergency Spillway Crest: Not Applicable

F. Reservoir Surface Areas:

(1) At Principal Spillway Crest: 3.7 Acres

(2) At Top of Dam: 4.4 Acres

(3) At Emergency Spillway Crest: Not Applicable

G. Dam:

(1) Type: Earth Fill

(2) Length at Crest: 290 Feet

(3) Height: 31 Feet

(4) Top Width: 15 Feet

(5) Side Slopes: Upstream 2.7:1; Downstream 2.5:1

(6) Zoning: Homogeneous - No internal drainage

(7) Impervious Core: None

(8) Cutoff: The owner indicated that a 4 foot to 6 foot deep core trench was dug prior to construction of the dam. The core trench was not carried up the embankment.

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: None

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location: South abutment

(2) Type: Trapezoidal cut in natural earth

I.2 Emergency Spillway:

(1) Location: None

(2) Type: Not Applicable

J. Regulating Outlets:

There are no regulating outlets other than the primary spillway.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exists for this dam. No construction inspection records or documented maintenance and operation data exist to our knowledge.

A. Surveys:

No detailed surveys have been made of the dam to our knowledge. The bench mark used in the inspection survey is shown on Sheet 3 of Appendix A.

B. Geology and Subsurface Materials:

The site is located at the western edge of the Ozarks geologic region of Missouri. This region is characterized topographically by hills, plateaus and deep valleys. The bedrock underlying the site is a cherty dolomite and limestones. The Geologic Map of Missouri shows the Strafford fault and another fault running in an east-west direction approximately 1/2 mile south of the dam site. The Department of Natural Resources has said that the faults in this area are generally considered to be inactive and have been for several hundred million years (rock associated with the Mississippian and Ordovician Periods are 300 to 500 million years old). The publication "Caves of Missouri" lists three caves in Webster County and that they are several miles south of the dam site.

The soils on the site are of the Clarksville series. These soils are residual from cherty and dolometic limestones. The Clarksville series covers large areas of the Ozarks region. The soil has a very low organic content and little fertility. The surface soil is a light gray to pale yellow silt. Below this thin first horizon the color of the soil becomes darker, a reddish yellow to a dull red cherty silty clay and becoming more red with increasing depth. Because of the high chert content, the permeability of the soil is increased and surface water is able to penetrate quickly. Erosion control is rarely a problem. The easy penetrability of the soil has permitted the leaching out of much of the iron oxide which has often times caused a loss of the red color in the lower soil layers. The mixture of silty clay soil and chert rock fragments makes good fill material.

C. Foundation and Embankment Design:

No design computations are available. The owner indicated that the dam is composed of materials taken from the lake area upstream of the dam. The valley bottom was stripped of soft material until good red clay was encountered. Our site inspection indicates that these materials are primarily cherty silty clays. No internal drainage features were incorporated, nor is there any particular zoning of the embankment. No construction inspection records are available.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design data were obtained. Our analyses of the PMF are presented in Appendix C. These analyses were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass 14 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will not overtop the dam.

E. Structure:

There are no appurtenant structures other than the earth spillway.

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION AND MAINTENANCE:

There are no operating records to our knowledge.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analysis, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspec-

tion of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

No valid engineering data on the design or construction of the embankment are available to our knowledge.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 16 May 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Tom Beckley P.E.- Anderson Engineering, Inc. (Civil Engineer)
Steve Brady P.E.- Anderson Engineering, Inc. (Civil Engineer)
Jack Healy P.E.-Hanson Engineers, Inc.(Geotechnical Engineer)
Nelson Morales P.E.- Hanson Engineers, Inc. (Hydrologic and Hydraulic Engineer)

B. Dam:

The dam appears to be generally in good condition. No sloughing was noted on the embankment. Two areas of seepage were observed. These were at the downstream right abutment contact at about half way up the embankment and at the toe of the dam near the center. No sediment was observed coming out in either seep area. No boils were observed in the seepage areas. The owner said that the seepage has existed for several years and that the amount of seepage has been about the same. Considerable iron oxide is present in the wet area below the toe of the dam as shown in Picture No. 13 in Appendix D. Picture No. 20 in Appendix D shows a white rock at the right downstream abutment contact about one-half way up the embankment. This is the highest point at which seepage is coming out at the contact (El. 71.88).

The dam was built with a curve which is concave to the downstream direction. The dam is fairly level across the crest and no surface cracking or unusual movement was obvious. The surface of the embankment is covered with chert rocks and some short grass. Some thicker grass is present at the right abutment contact. Some erosion was noted on the downstream face of the embankment. No animal burrows were noted. Riprap was not evident on the front face however the owner said that some was placed from the bottom of the dam up to a point about 10 feet below normal pool elevation. Nevertheless, some vegetation has grown above normal pool and has protected the embankment from erosion due to wave action.

A spring exists at the toe of the dam in the left abutment (see Photo No. 11 in Appendix D). The owner said that the spring was there before the dam was built and the dam was built just upstream of the spring. The owner also said that there was no noticeable change in flow of the spring after the lake filled.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The spillway is excavated into the south abutment and runs parallel to the valley for approximately 150 feet before dropping into the valley just downstream of the toe of the dam. The upper part of the spillway is grass covered and the approach from the lake is clear. The channel has heavily eroded where it drops to the valley floor. Near the base the channel has eroded down to bedrock. The spillway discharge is downstream of the toe and doesn't appear that it would affect the embankment. Considerable trees and brush line the spillway channel in the portion that drops to the valley floor, however, they do not appear to hamper the flow at this time.

C.2 Emergency Spillway:

None

D. Reservoir:

The watershed is timber and pastureland. Its slopes adjacent to the lake are moderate and no sloughing or serious erosion was noted. The owner indicated no problem with siltation and none was observed.

E. Downstream Channel:

The downstream channel is grass covered. Some brush and tree growth are also present.

3.2 EVALUATION:

The erosional areas on the downstream face should be corrected and maintained. The seepage areas at the right abutment downstream face and at the downstream toe of the

embankment should be investigated by a professional engineer experienced in the design and construction of dams. Trees and brush that develop on the embankment should be cleared on an annual basis. The spillway channel should also be kept clear of trees and brush. The spillway control section should be lined to prevent erosion under continued use.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam. The spillway is uncontrolled, so that the pool is normally affected by rainfall, runoff, evaporation and seepage.

4.2 MAINTENANCE OF DAM:

The embankment is in generally good condition and is apparently maintained by the owner.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Not applicable

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Trees or brush should be cleared on the dam as they develop on an annual basis. Removal of large trees should be under the guidance of a professional engineer experienced in the design and construction of earthen embankments. Erosional areas on the downstream face of the embankment should be corrected and maintained.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field check of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. The hydrologic and hydraulic analyses using U.S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

Some erosion protection for the control section of the spillway would appear to be advisable. The spillway channel down to the valley floor should be kept clear of trees and brush. The spillway outlet channel ends downstream of the toe of the embankment and spillway releases would not be expected to endanger the dam.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillway will pass 14 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the small volume of water impounded, and the height of the dam, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will not pass a 100-year frequency flood without overtopping.

The routing of 50 percent of the PMF through the spillway and dam indicate that the dam will be overtopped by 0.62 ft. at elevation 90.62. The duration of the overtopping will be 4.58 hours and the maximum outflow will be 571 cfs. The maximum discharge capacity of the spillway is 75 cfs.

The routing of the 100-year frequency flood indicates

that the dam will be overtopped by 0.33 ft. at elevation 90.33. The duration of the overtopping will be 0.67 hours and the maximum outflow will be 274 cfs. Analysis of this routing indicates that the dam will pass the 10-year frequency flood without overtopping.

Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Visual observations which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data for the foundation and embankment were available. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

The owner said that an attempt was made a few years ago to stop the seepage in the right abutment contact. During a summer period when the lake was down a dozer was used to spread and compact a clay layer along the inside contact. This attempt was unsuccessful as the seepage continued.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be corrected or controlled. These items are: (1) Erosion on the downstream face of the embankment above the spring, (2) Seepage at the downstream right abutment contact, (3) Seepage at the center of the dam at the downstream toe, and (4) The spillway should be protected against erosion.

The dam will be overtopped by flows in excess of 14 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the future. Priority should be given to increasing the size of the spillway.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

(1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

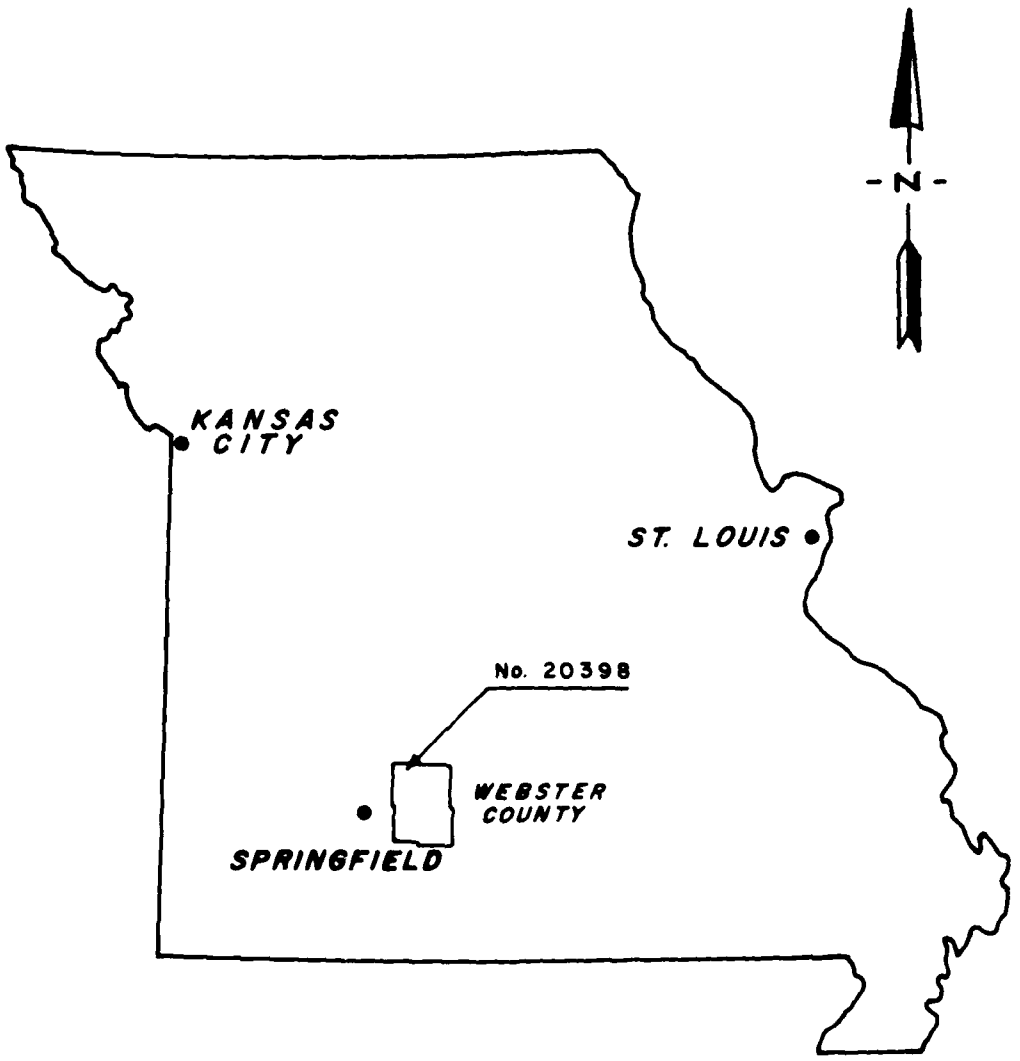
(2) Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

(3) The seepage areas at the downstream toe should be evaluated by an engineer experienced in the design of dams.

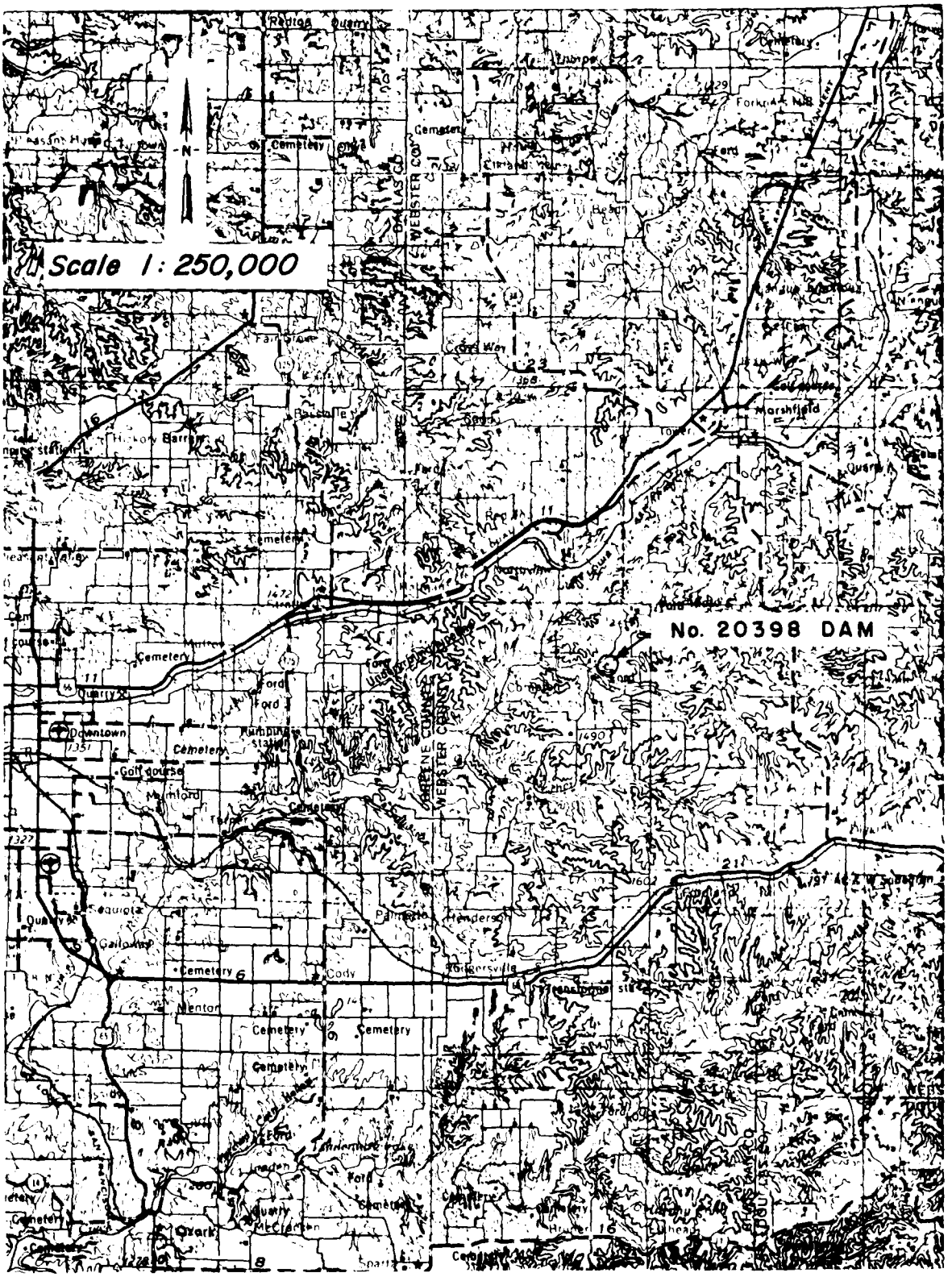
(4) Erosional areas on the downstream face should be corrected and maintained.

(5) A detailed inspection of the dam should be made periodically by a professional engineer experienced in the design and construction of dams.

APPENDIX A

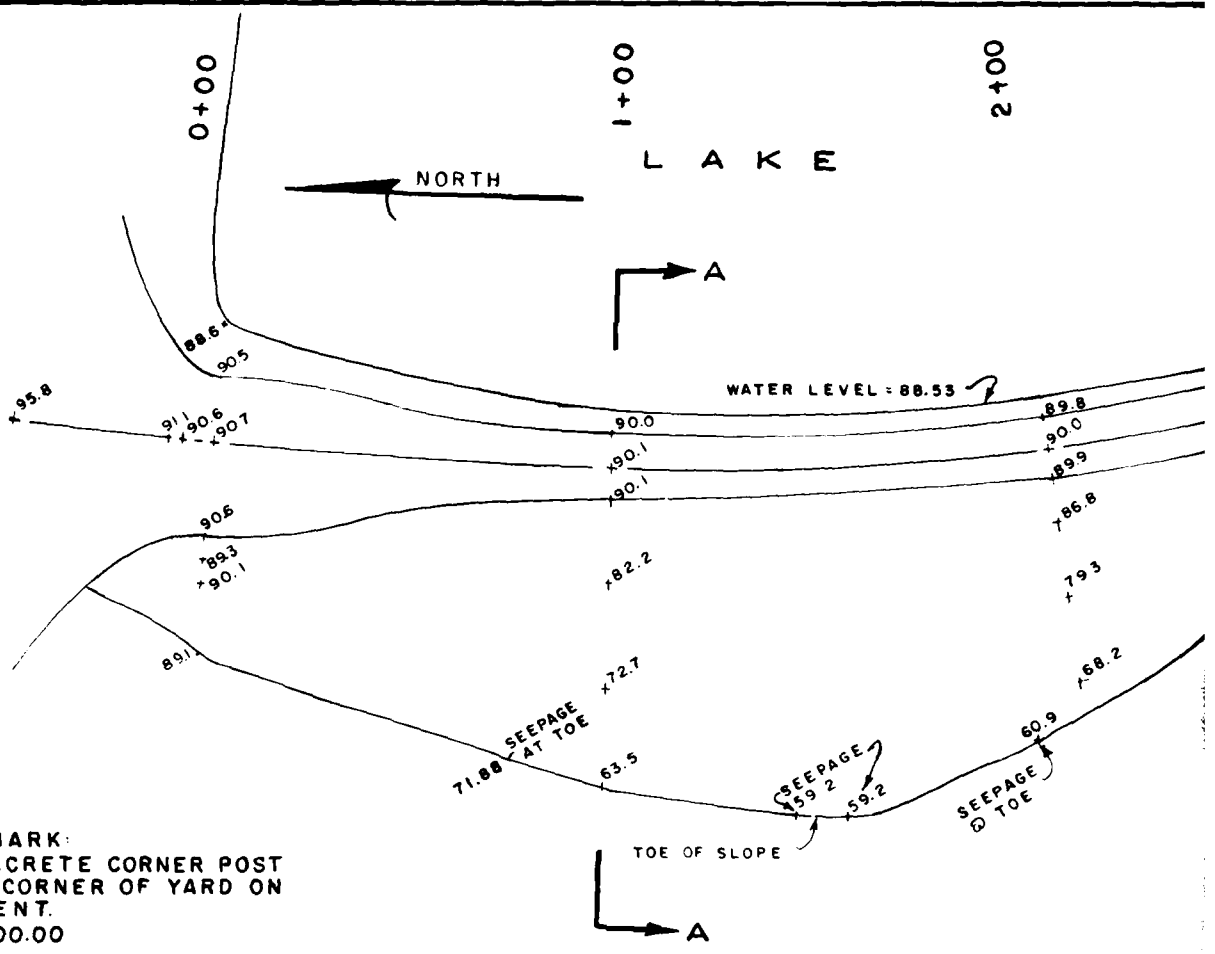


LOCATION MAP



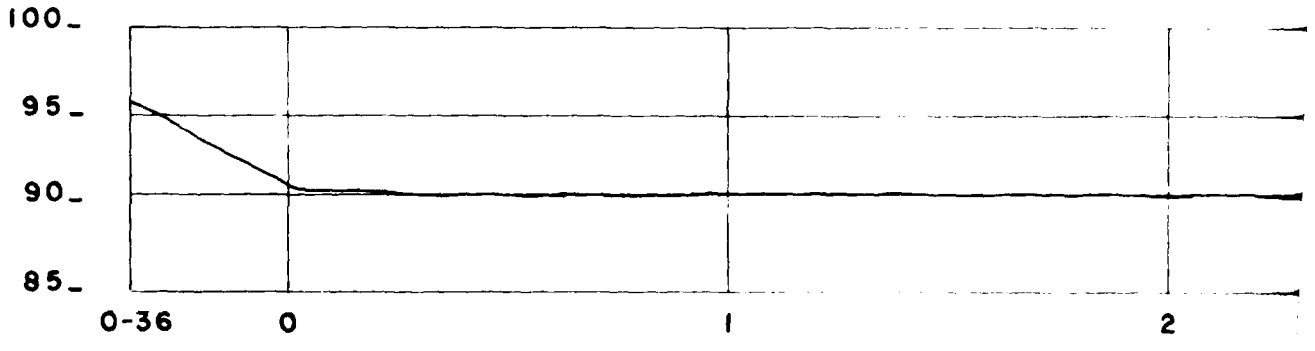
SITE VICINITY MAP

Sheet 2 Appendix A



BENCHMARK:
TOP CONCRETE CORNER POST
AT S W CORNER OF YARD ON
ABUTMENT.
ELEV. 100.00

PLAN VIEW
SCALE: 1" = 40'



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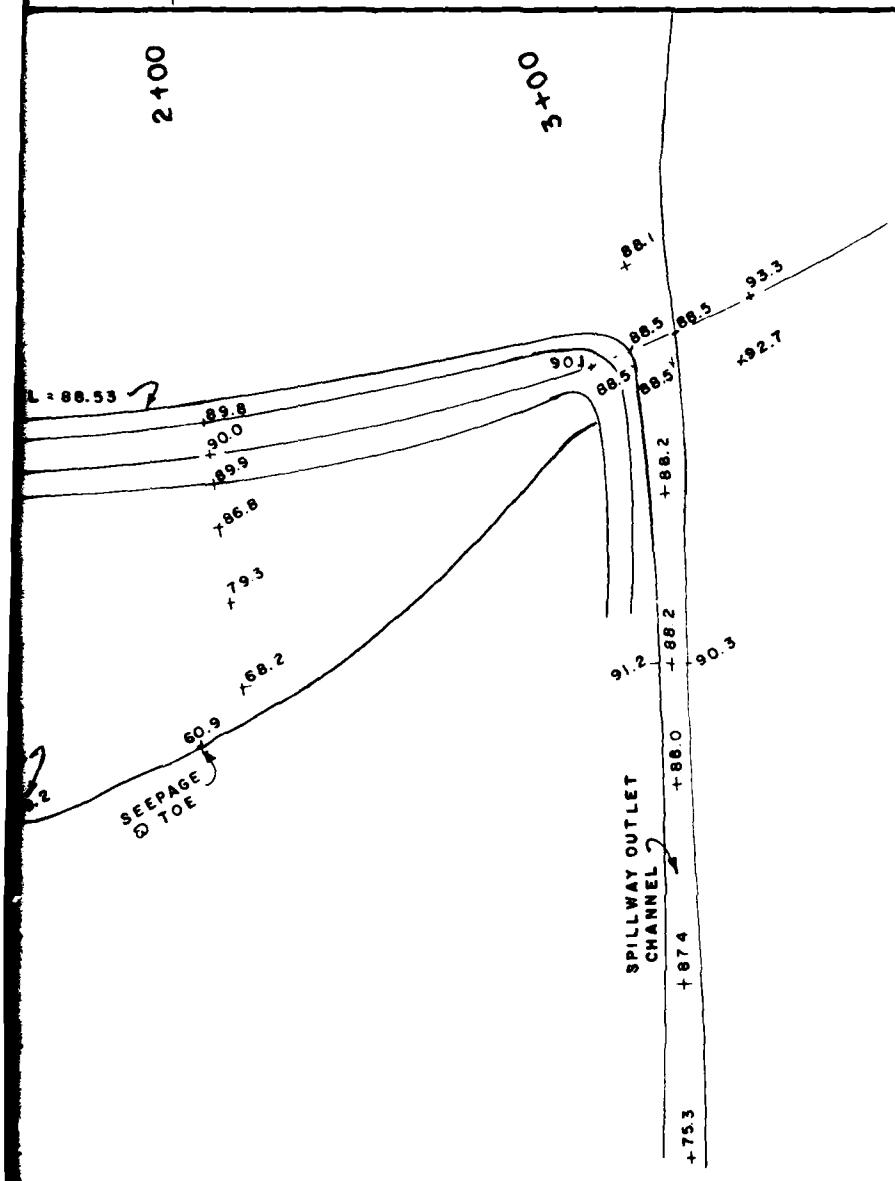
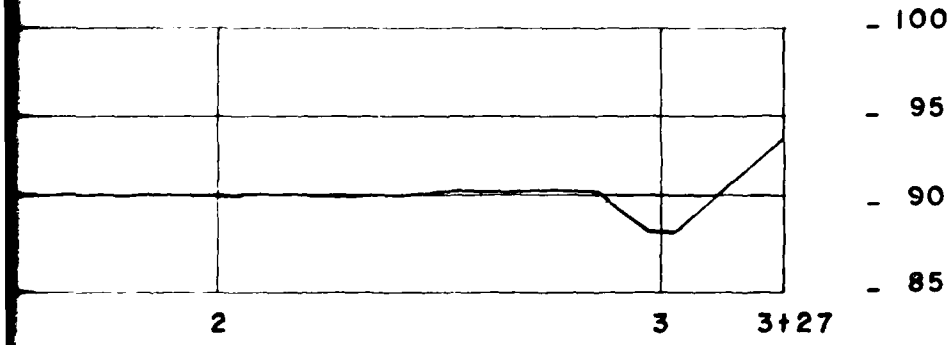
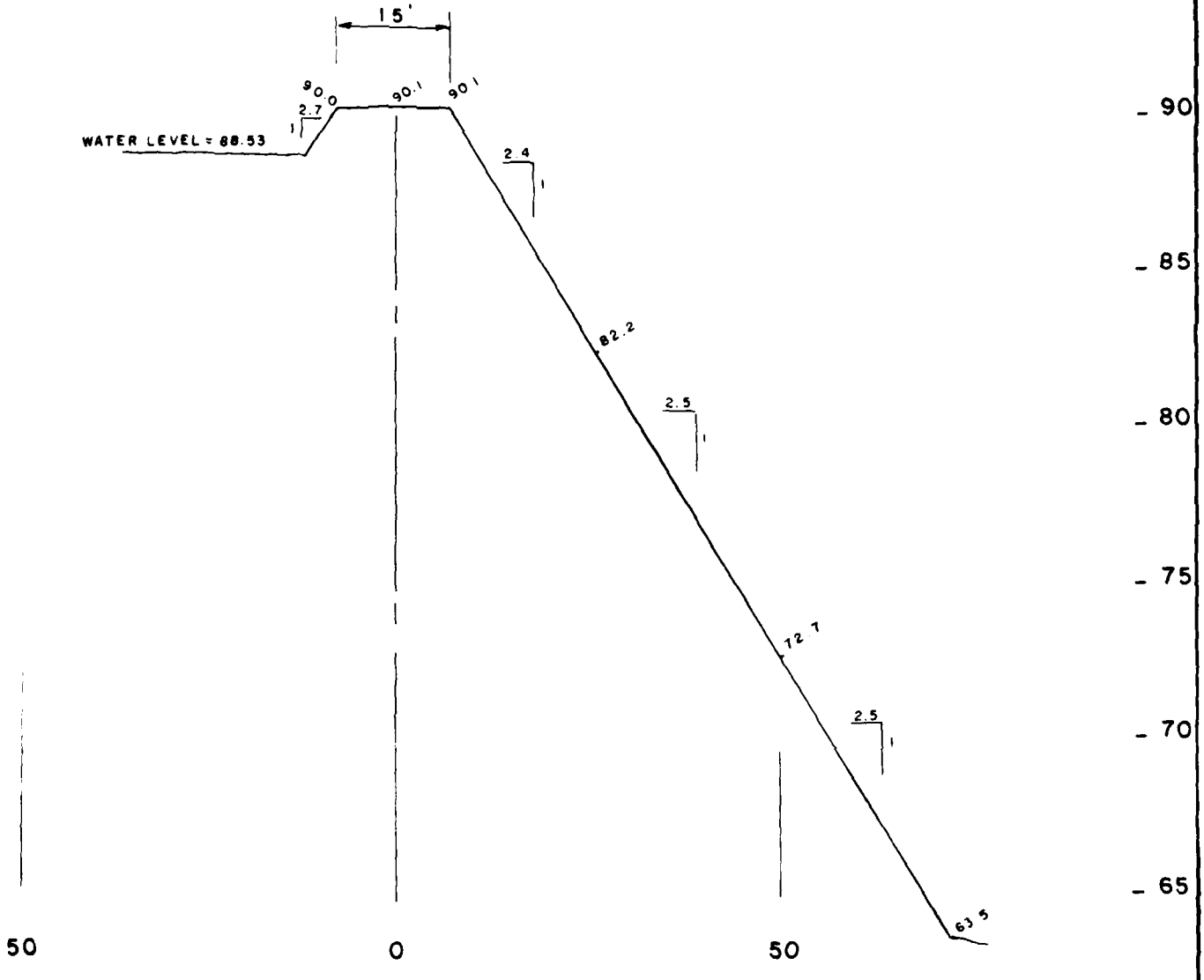

2+00
3+00
+88.1
+93.3
88.5
88.5
88.5
88.5
+92.7
90.1
86.5
+88.2
L = 88.53
89.8
90.0
89.9
86.8
79.3
68.2
60.9
91.2
88.2
90.3
88.0
SEEPAGE TOE
SPILLWAY OUTLET CHANNEL
87.4
75.3

50


100
95
90
85
2
3
3+27

PROFILE



SECTION A-A STA 1+00

ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

F. A. TOTTEN LAKE

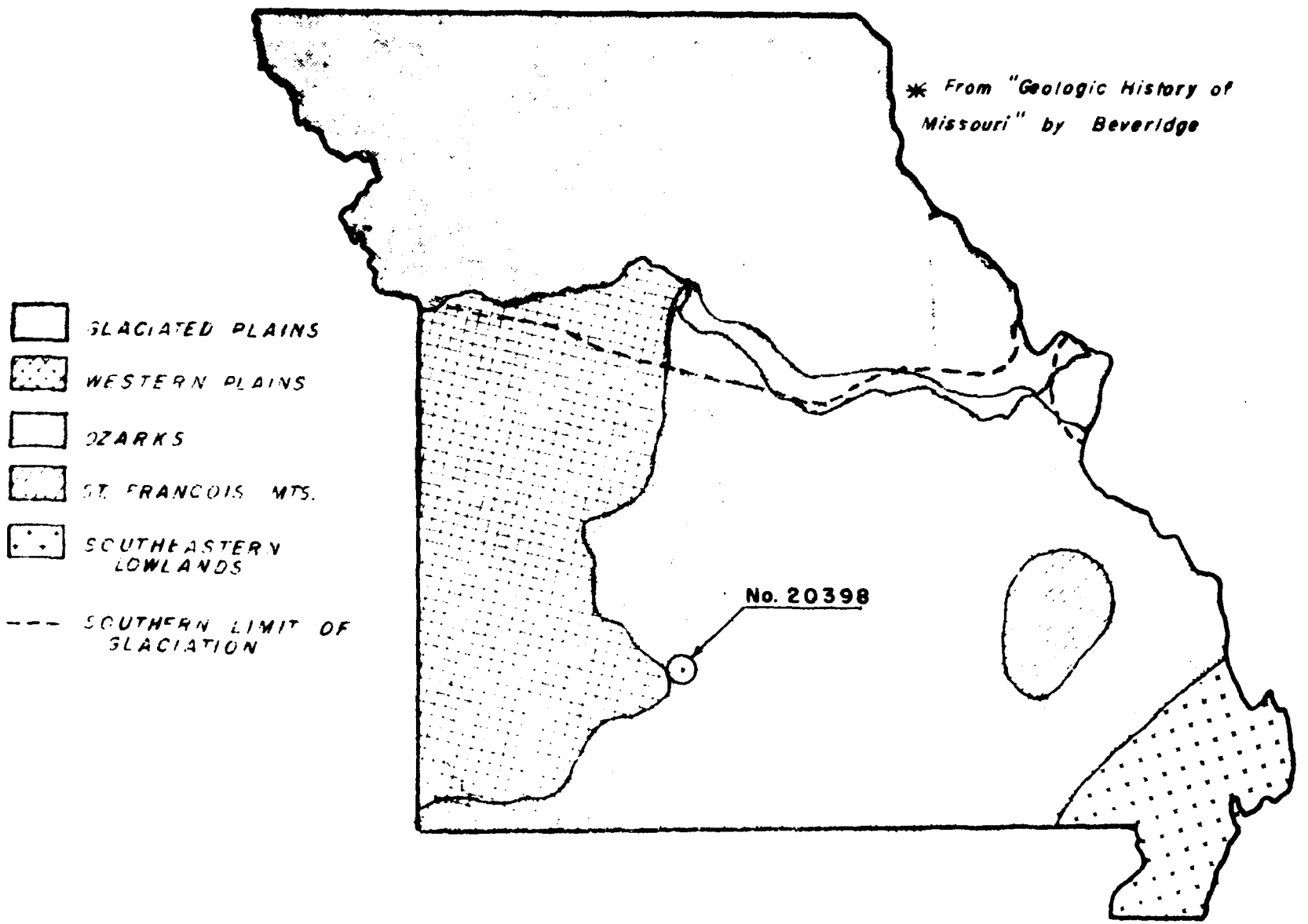
MO. No. 20398

PLAN & PROFILE

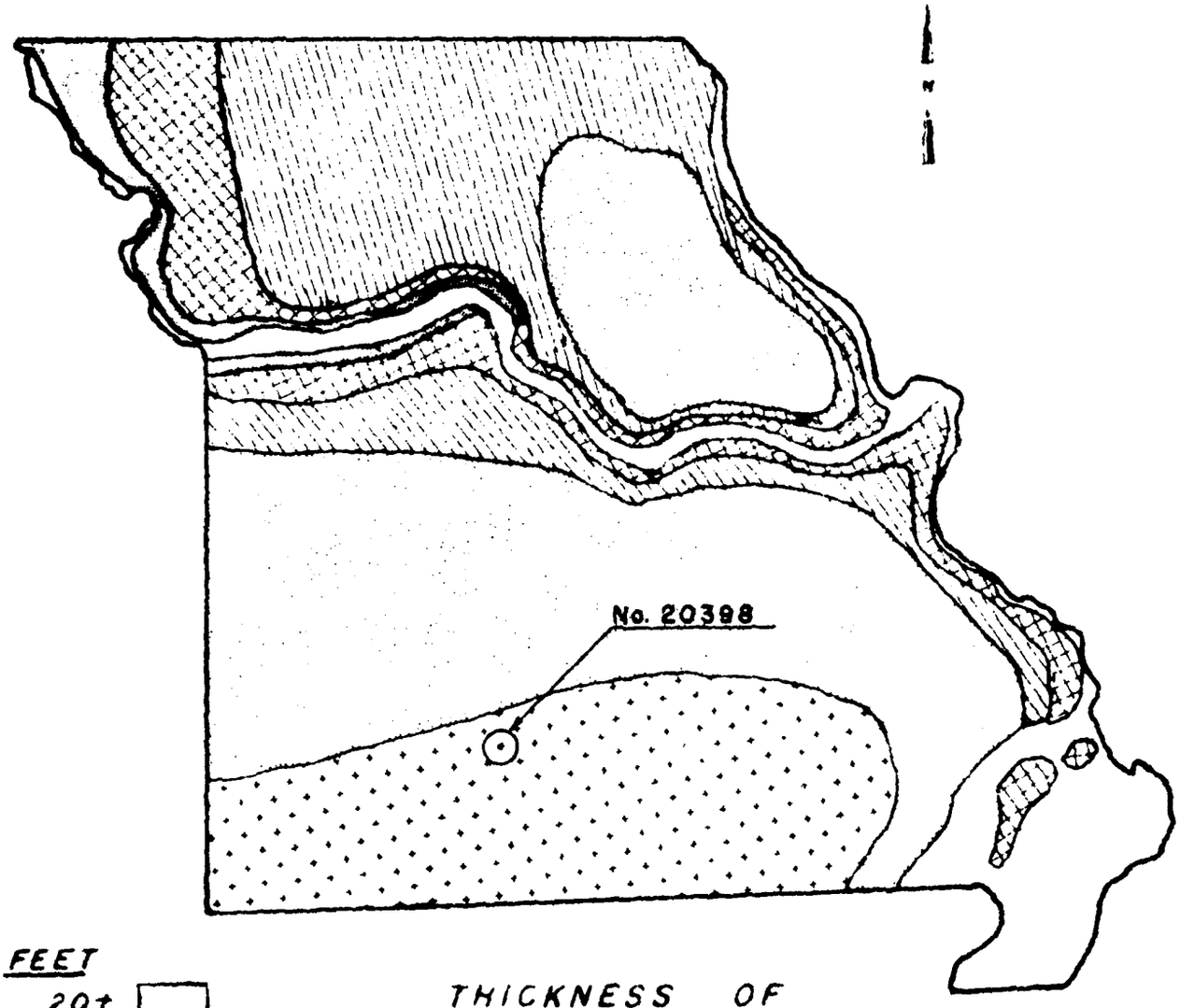
WEBSTER COUNTY, MO.

APPENDIX B

MAJOR GEOLOGIC REGIONS OF MISSOURI



* From "Soils of Missouri"



FEET

20+

10-20

5-10

2.5-5

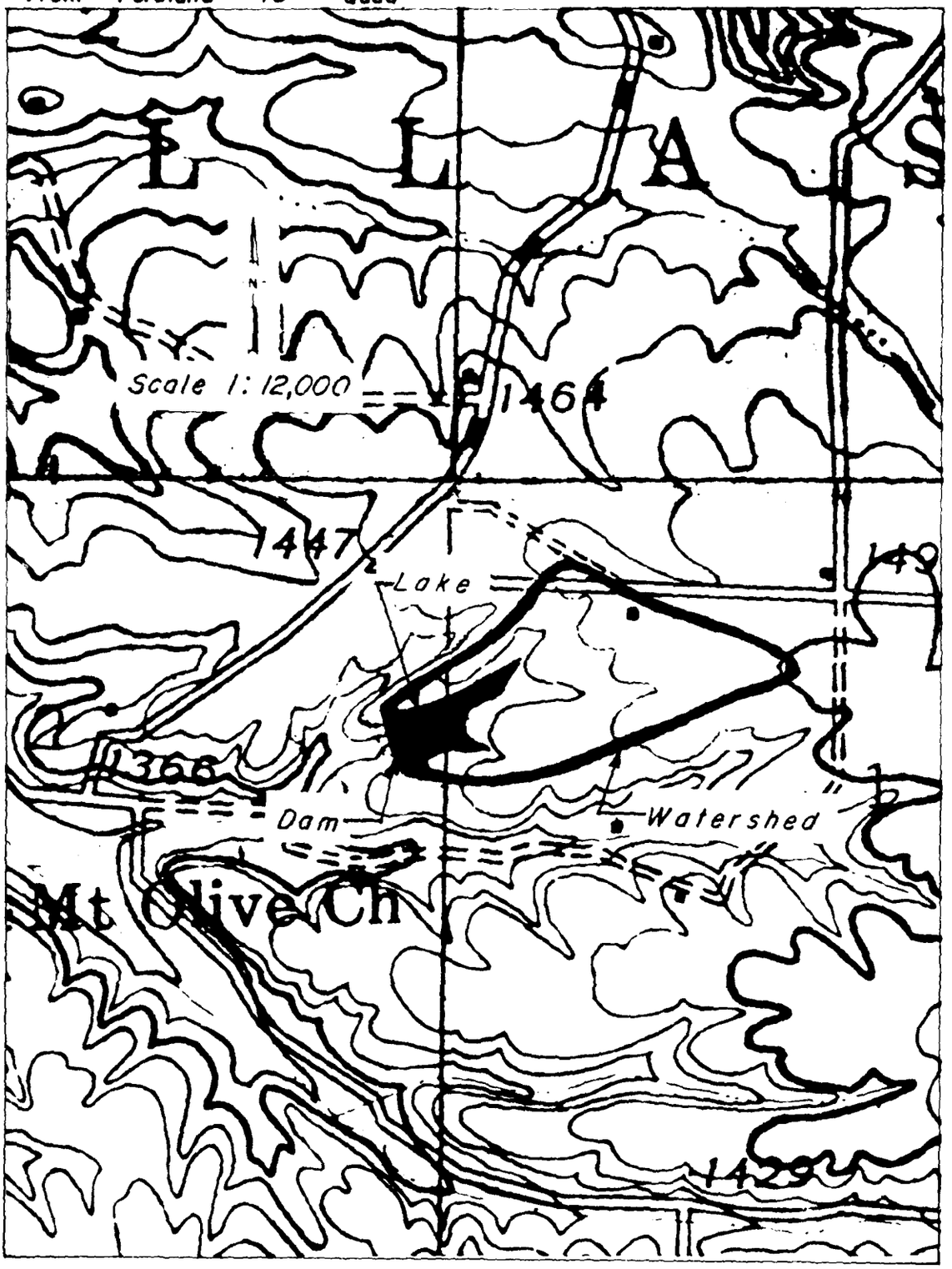
2.5-

THICKNESS OF LOESSIAL DEPOSITS

SHEET 2 OF APPENDIX B

APPENDIX C

From Fordland 15' Quad



LAKE AND WATERSHED MAP

Sheet 1 Appendix C

HYDRAULICS AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. The owner, Mr. F. A. Totten, indicated that the dam has never been overtopped and that the spillway operated under few inches of head during heavy rain. The day of the inspection there was no indication of high water marks or overtopping. Erosion at the end of the spillway outlet channel has progressed down to the bedrock.

Visual Inspection: At the time of inspection, the pool level was approximately 0.13 feet above normal pool.

Overtopping Potential: Flood routing studies were performed to determine the overtopping potential of the dam. The watershed was obtained by planimeter from the U.S.G.S. Fordland, Missouri 15 minute quadrangle map and the reservoir surface area from the Fordland, Missouri 7.5 minute orthophotoquad (advance print). The storage volume was developed from this data. A 5 minute interval unit graph was developed for this watershed, which resulted in a peak inflow of 284 c.f.s. and a time to peak of 15 minutes. Application of the probable maximum precipitation minus losses results in a flood hydrograph peak inflow of 1268 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

Based on our analyses, the spillway will pass 14 percent of the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that the structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering that the maximum storage is only 42 acre-feet and the height of the dam is 31 feet, 50 percent of the PMF has been determined to be the appropriate spillway design flood.

The routing of the 50 percent of the PMF through the spillway and dam indicates that the dam will be overtopped by 0.62 feet at elevation 90.62. The duration of the overtopping will be 4.58 hours, and the maximum outflow will be 571 c.f.s. The maximum discharge capacity of the spillway is 75 c.f.s.

The routing of the 100-years frequency flood indicates that the dam will be overtopped by 0.33 feet. Analysis of this routing indicates that the dam will pass the 10-year frequency flood without overtopping.

OVERTOPPING ANALYSIS FOR F. A. TOTTEN DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.
   Hydraulic Inputs Are as Follows:

   a. Twenty-four Hour Rainfall of 26.7 Inches for 200 Square Miles - All Season Envelope

   b. Drainage Area = 56 Acres; = 0.088 Square Miles

   c. Travel Time of Runoff 0.20 Hrs.; Lag Time 0.12 Hrs.

   d. Soil Conservation Service Soil Group B

   e. Soil Conservation Service Runoff Curve No. 80 (AMC) III

   f. Proportion of Drainage Basin Impervious 0.07

2. Spillways

   a. Primary Spillway: Trapezoidal Cut, Side Slopes 4:1 and 5.5:1, Bottom Width 8 ft.

   b. Emergency Spillway: None

      Length -- ft.; Side Slopes --; C = --

   c. Dam Overflow

      Length 290 ft.; Crest El. 90.0; C = 3.0

3. Spillway and Dam Rating:

   Curve prepared by Hanson Engineers. Data provided to computer on Y4 and Y5 cards.

   Equation Used: Spillway: $\frac{Q^2}{g} = \frac{A^3}{T}$

   Dam: $CLH^{1.5}$

Note: Time of Concentration From Equation $Tc=\left(\frac{11.9\ L^3}{H}\right)^{.385}$

California Culvert Practice, California Highways and Public Works, Sept. 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph for the PMF

   a. Peak - 284 c.f.s.

   b. Time to Peak 15 Min.

2. Flood Routings Were Computed by the Modified Puls Method

   a. Peak Inflow

      50% PMF 634 c.f.s.; 100% PMF 1268 c.f.s.

   b. Peak Elevation

      50% PMF 90.62; 100% PMF 91.07

   c. Portion of PMF That Will Reach Top of Dam

      14% ; Top of Dam Elev. 90.0 Ft.

3. Computer Input, Output and Hydrograph Data are shown on the following sheets of this Appendix.

```
A       OVERTOPPING ANALYSIS FOR DAM NO8 OUNER F.A. TOTTEN
A       STATE ID NO 20398 CO. NO. 225 NAME FORDLAND
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B    300                5
B1     5
J      1        8        1
J1   .10      .15      .20      .25      .30      .50      .70      1.0
K      0        1                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION
N      1        2    0.088             0.088        1                        1
P      0     26.7      102      120      130
T                                                             -1      -80              0.07
U2  0.20     0.12
X      0     -.1        2
K      1        2                           0        4        1
K1       RESERVOIR ROUTING BY MODIFID PULS AT DAM SITE
Y                                   1        1
Y1     1                                                   36.4       -1
Y4  88.5     89.5     90.0     90.5     91.0     91.5     92.0     92.5     93.0     94.5
Y5     0       35       75      130      205      290      400      535      710     1310
$A     0      3.7      4.4
$E  59.0     88.5     93.5
$$  88.5
$D  90.0      3.0      1.5      290
K     99
```

P.M.F. INPUT DATA

SHEET 5 APPENDIX C

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS							
OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8
				0.10	0.15	0.20	0.25	0.30	0.50	0.70	1.00
HYDROGRAPH AT	1	0.09	1	127.	190.	254.	317.	381.	634.	888.	1268.
	(	0.23)	(	3.59)(	5.39)(	7.18)(	8.98)(	10.78)(	17.96)(	25.14)(	35.92)
ROUTED TO	2	0.09	1	46.	93.	198.	278.	339.	571.	808.	1175.
	(	0.23)	(	1.30)(	2.64)(	5.62)(	7.87)(	9.61)(	16.18)(	22.89)(	33.28)

SUMMARY OF DAM SAFETY ANALYSIS

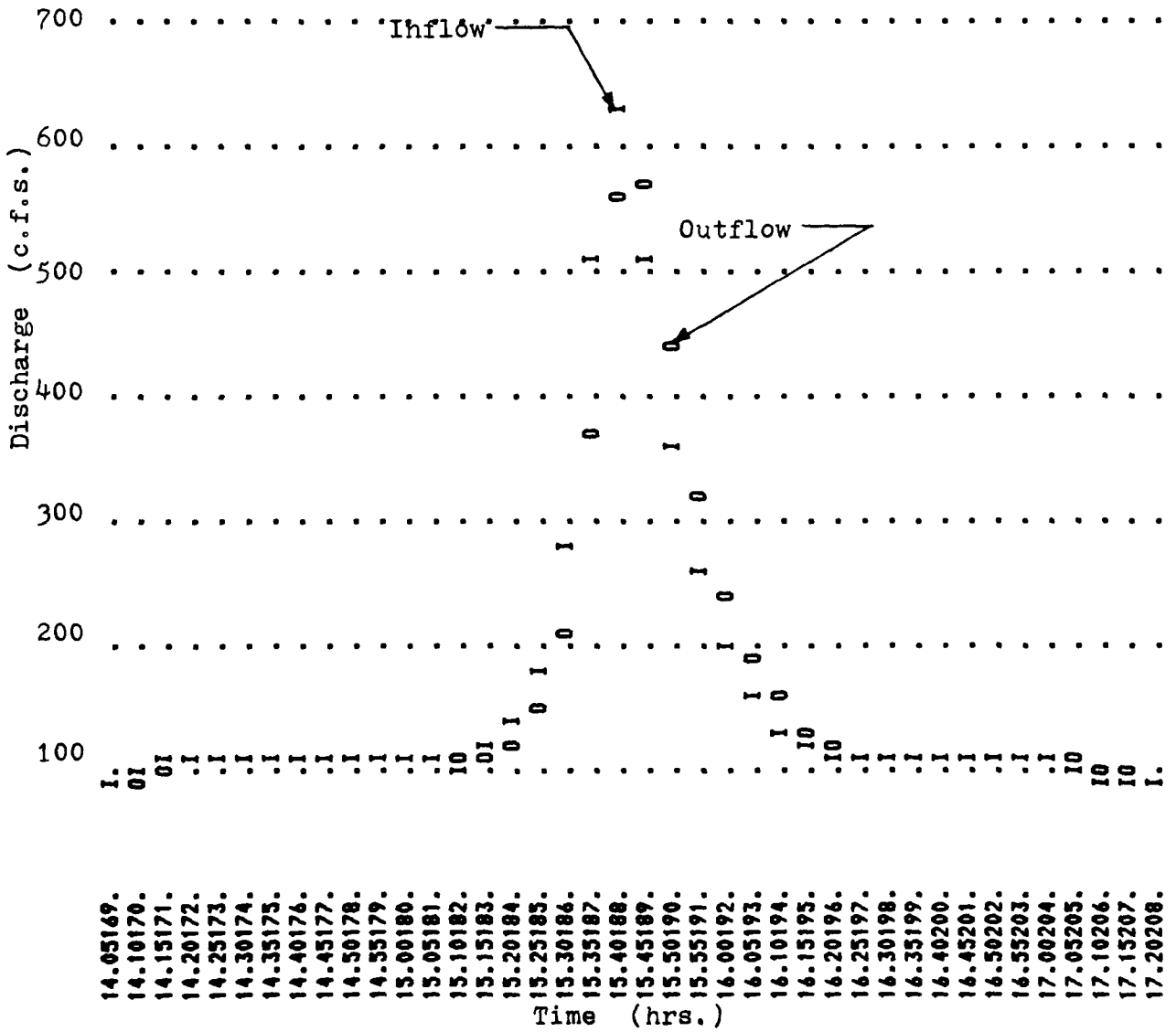
PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	88.50	88.50	90.00
STORAGE	36.	36.	42.
OUTFLOW	0.	0.	75.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	89.64	0.00	41.	46.	0.00	16.00	0.00
0.15	90.06	0.06	42.	93.	0.25	15.92	0.00
0.20	90.23	0.23	43.	198.	0.58	15.75	0.00
0.25	90.33	0.33	43.	278.	0.75	15.75	0.00
0.30	90.40	0.40	44.	339.	1.00	15.75	0.00
0.50	90.62	0.62	45.	571.	4.58	15.75	0.00
0.70	90.81	0.81	45.	808.	5.67	15.67	0.00
1.00	91.07	1.07	46.	1175.	6.30	15.67	0.00

INFLOW - OUTFLOW
HYDROGRAPH
FOR 50% P. M. F.

Max. Inflow = 634 c.f.s.

Max. Outflow = 571 c.f.s.



```
A       OVERTOPPING ANALYSIS FOR DAM NO.8 OWNER T.A. TOTTEN  (100 YR. FLOOD)
A       STATE ID NO 20398 CO. NO. 225 NAME FORDLAND
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B    288                5
B1     5
J      1        1        1
J1   1.0
K      0        1                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION
M      0        2   0.088             0.088        1                    1
O    288      8.0
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
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O1  .007     .007     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .015     .015     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .033     .033     .033     .034
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O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1  .015     .015     .015     .015     .015     .015     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007
T                                                          -1      -80              0.07
W2 0.20     0.12
X      0      -.1        2
K      1        2                             2        4        1
K1       RESERVOIR ROUTING BY MODIFID PULS AT DAM SITE
Y                                   1        1
Y1     1                                                  36.4      -1
Y4  88.5     89.5     90.0     90.5     91.0     91.5     92.0     92.5     93.0     94.5
Y5     0       35       75      130      205      290      400      535      710     1310
$A     0      3.7      4.4
$E  59.0     88.5     93.5
$$  88.5
$D  90.0      3.0      1.5      290
K     99
```

100 YR. FLOOD INPUT DATA

SHEET 8 APPENDIX C

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

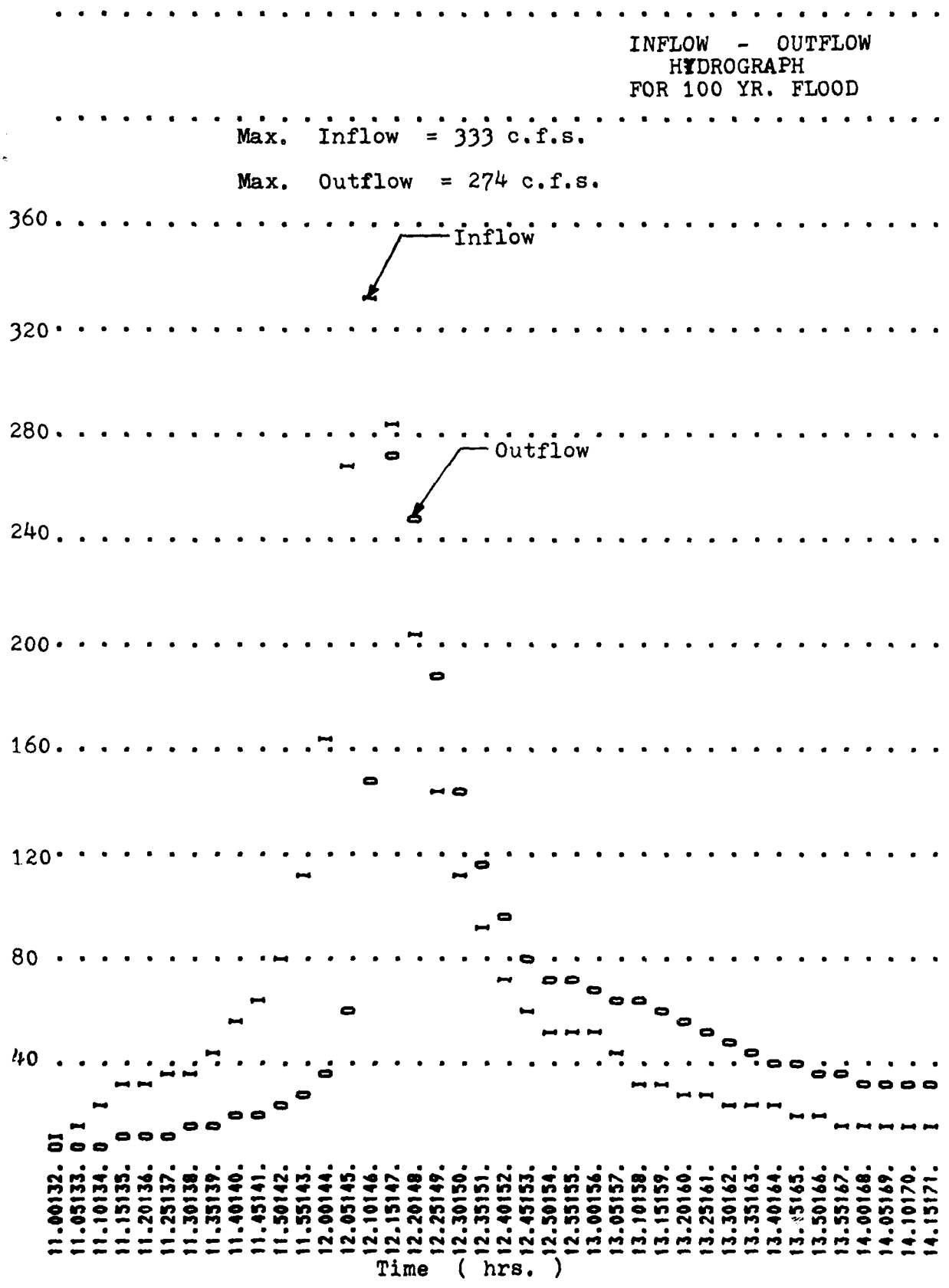
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	1	0.09	1	333.
		(0.23)		(9.42)(
ROUTED TO	2	0.09	1	274.
		(0.23)		(7.75)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	88.50	88.50	90.00
STORAGE	36.	36.	42.
OUTFLOW	0.	0.	75.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	90.33	0.33	43.	274.	0.67	12.25	0.00


INFLOW - OUTFLOW
HYDROGRAPH
FOR 100 YR. FLOOD
Max. Inflow = 333 c.f.s.
Max. Outflow = 274 c.f.s.
Inflow
Outflow
360
320
280
240
200
160
120
80
40
Time (hrs.)

APPENDIX D

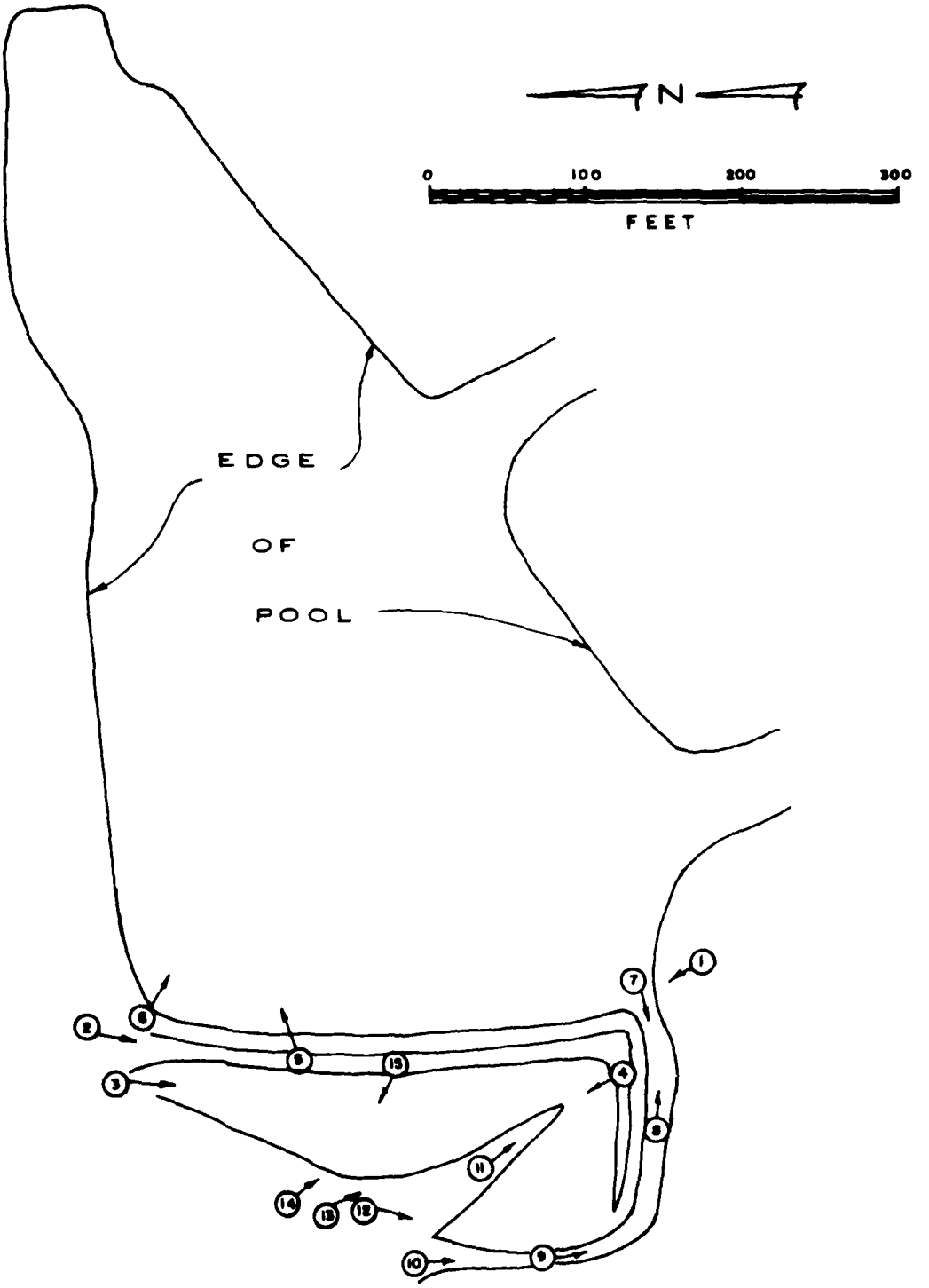


PHOTO INDEX

F. A. TOTTEN LAKE

WEBSTER COUNTY, MO.

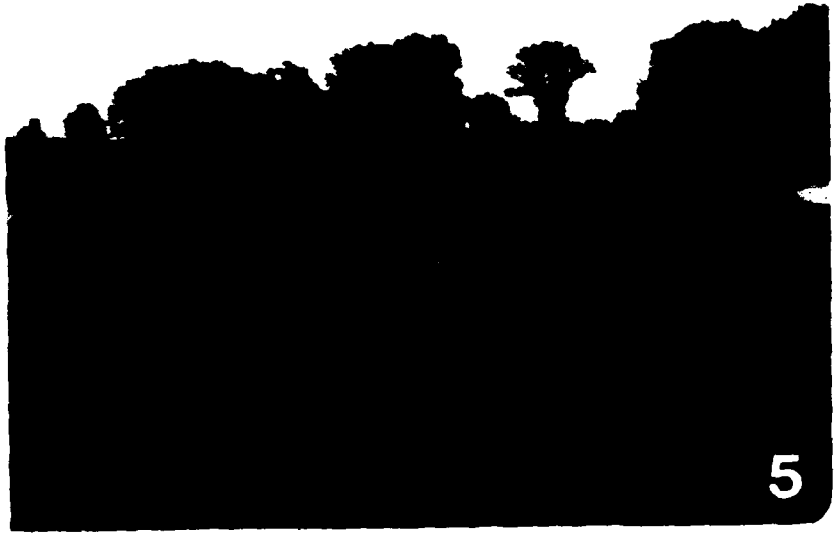
LIST OF PHOTOGRAPHS

Photo No.	
1.	Front Face of Dam
2.	Crest of Dam
3.	Downstream Face of Dam Looking South
4.	Downstream Face of Dam Looking Northwest
5.	Lake and Reservoir Area
6.	Lake and Reservoir Area
7.	Primary Spillway Looking Downstream
8.	Primary Spillway Looking Upstream
9.	Primary Spillway Channel
10.	Primary Spillway Channel
11.	South Abutment Contact (Note Old Spring)
12.	Spillway Outlet Channel (Discharge Area)
13.	Seepage at Toe of Dam
14.	Seepage at Toe of Dam
15.	Downstream Channel from Dam
16.	Aerial Photo Looking North
17.	Aerial Photo Looking Southwest
18.	Aerial Photo Looking Southeast
19.	Aerial Photo Looking South
20.	Aerial Photo of Dam


1


3


4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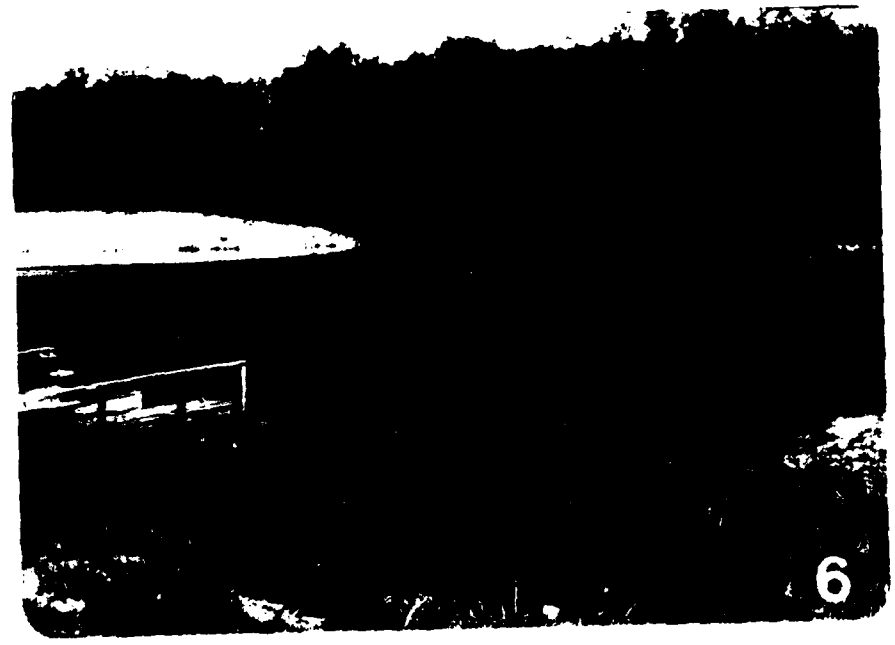
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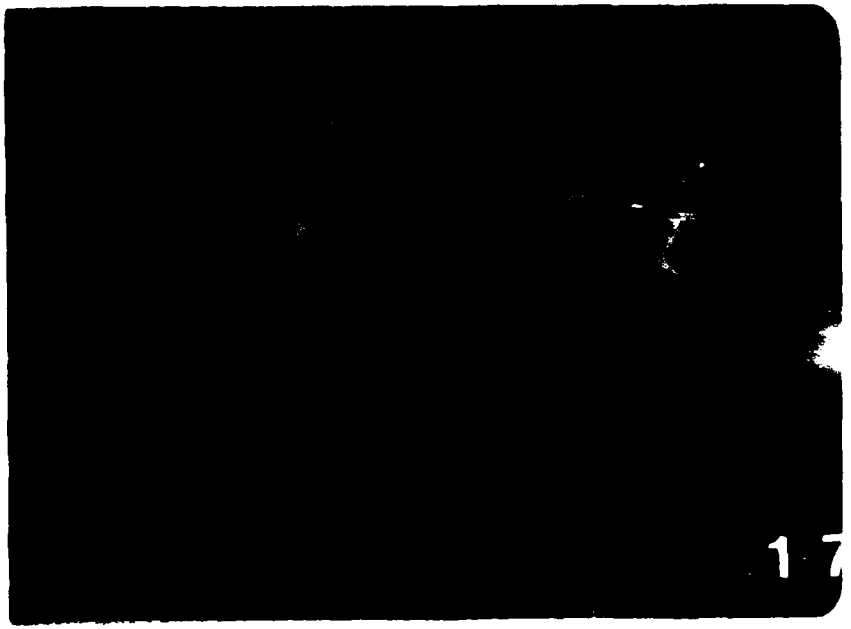
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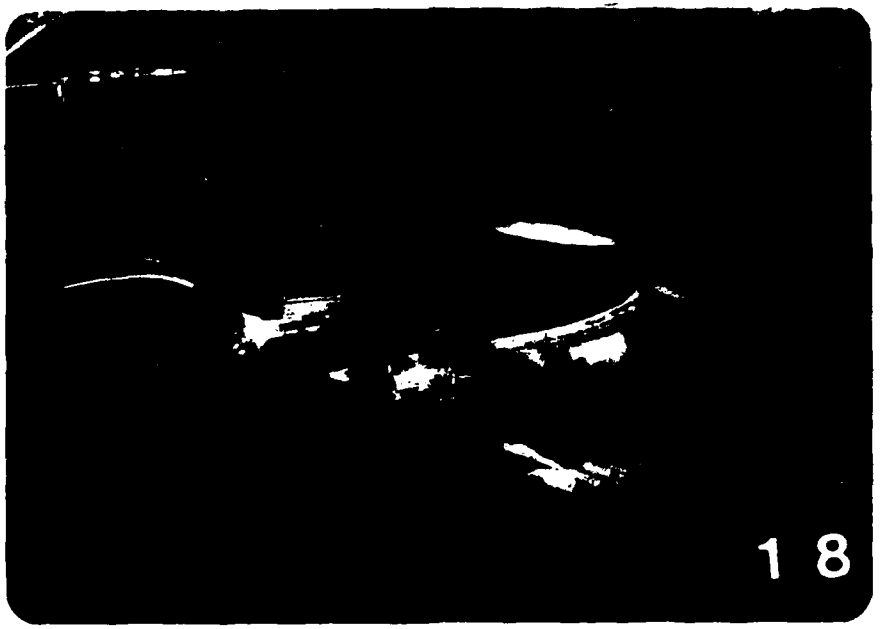
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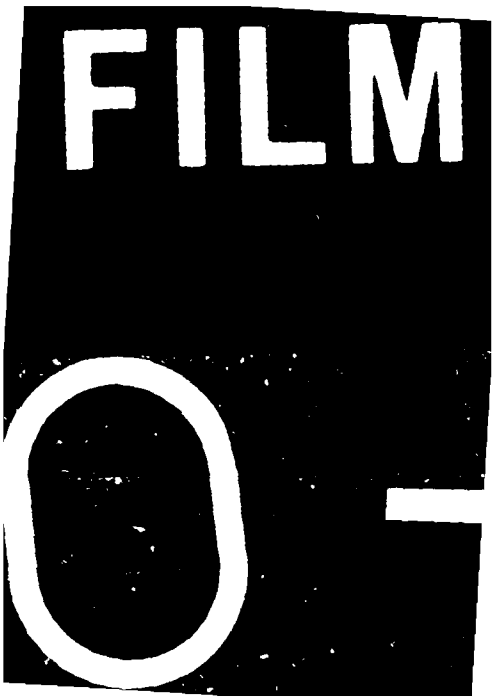
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